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ABSTRACT

A pilot study to ascertain the most cost-efficient and statistically reliable way of obtaining data on drug use by means of the telephone was conducted. Typically, surveys of sensitive or stigmatizing information have been contaminated by an unknown amount of error due to evasive or incorrect responses. The randomized response technique, which reduces bias by providing privacy or confidentiality for respondents, is described. Data is presented comparing the randomized response technique and direct questioning as ways of asking the survey items and obtaining valid results. For this pilot study, 203 households in the five boroughs of New York City were interviewed. Results indicated that there were no significant differences in the rates of cocaine, PCP, LSD, and heroin use described by the 88 persons that were questioned directly and 60 that used the randomized response technique. Results of chi-square tests conducted among the background characteristics of the respondents indicated that younger single persons who have used drugs may be more predisposed to the randomized response technique. (Author/RL)

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RANDOMIZED RESPONSE VERSUS DIRECT QUESTIONING: TWO METHODS FOR ASKING SENSITIVE QUESTIONS OVER THE TELEPHONE

by

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Abstract

Chilton Research Services (CRS) was commissioned by the New York State Division of Substance Abuse Services (DSAS) to conduct a pilot study to ascertain the most cost-efficient and statistically reliable way of obtaining data on drug use by means of the telephone. Typically, surveys of sensitive or stigmatizing information have been contaminated by an unknown amount of error due to evasive or incorrect responses. To reduce this bias, Warner (1965) originated the randomized response technique, which provided obvious privacy or confidentiality for respondents. This technique, however, has rarely been employed on the telephone.

This paper describes the underlying theory and resultant randomizing device which was employed. Data will be presented comparing the randomized response technique and direct questioning as ways of asking the survey items and obtaining valid results.

Randomized Response Versus Direct Questioning: Two Methods for Asking Sensitive Questions Over the Telephone

by

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In many surveys it becomes necessary to probe into and investigate areas often considered sensitive and embarrassing. Concern has been voiced by researchers in the area of substance abuse that many times the question is of such a sensitive nature that the respondent gives evasive or misleading replies which may bias true population characteristics. Reviews of the seriousness of the biases in self-reporting (e.g., Pernanen, 1974; Whitehead and Smart, 1972; Smart, 1975) indicate that while there appears to be no significant tendency to overreport drug use, there is evidence that significant underreporting occurs.

More than a decade ago, in an attempt to reduce this bias, Warner (1965) developed the randomized response technique (RRT). This method of determining the percentage of persons in a population who have a certain characteristic which may be socially undesirable allows the respondent in personal interview surveys to answer a sensitive question without the interviewer being able to interpret the response. With this guaranteed privacy of confidential information, it was hypothesized that respondents would be more willing to answer the question honestly.

In Warner's (1965) original presentation of this procedure, the respondent is presented with two dichotomous statements of a sensitive characteristic. For example:

Statement 1: I have had an abortion.
Statement 2: I have NOT had an abortion.

In addition, the respondent is given a random device (with known probability) such as a die by which to choose one of the statements at random. An example of a decision rule would be: "Roll your die and answer Statement 1 if a one or two comes up and answer Statement 2 if a 3, 4, 5, or 6 comes up." In this case the known probabilities would be: Statement 1, (1/6) + (1/6) or 1/3 and Statement 2, (1/6) + (1/6) + (1/6) + (1/6) or 2/3. When the respondent replies "Yes" or "No," it is made explicit that the interviewer, who has no knowledge of what was rolled on the die, is unable to determine to which statement the respondent's information refers. The only requirement for this technique is that P, the probability that the device will select Statement 1 is fixed for all respondents and not equal to one half. The sole information the survey researcher has is the Yes/No response for his sample plus the value of P. This is sufficient, however, to estimate the proportion of the population with this sensitive characteristic while at the same time protecting the privacy of the respondents.

A variation of the Warner technique was suggested by Simmons (1967) and designed to increase further the cooperation of respondents and the veracity of their responses. Simmons (1967) hypothesized that one could enhance the confidence of the respondent in the anonymity provided by

offering him two statements which did not refer to the same sensitive attribute. Instead of being asked about some Attribute A or the complement of Attribute A, the respondent should be asked about Attribute A or B, with B being an unrelated, innocuous attribute. For example, a respondent could be shown the following two statements:

Statement 1: I have used Heroin. (Attribute A)
Statement 2: I have watched television.
(Attribute B, the innocuous attribute)

The respondent is still given a random device to select by chance one of the two statements. And again, since the interviewer has no prior knowledge of which statement he is replying to, the response of "Yes" or "No" is actually devoid of any meaning. There is evidence to show that Simmon's modification of the randomized response technique gives more efficient estimators of the proportion of the population having a sensitive characteristic than Warner's model (Pollock and Bek, 1976).

One difficulty which arises in the administration of any variation of Warner's model is based on the fact that the technique was designed to be employed with personal interview surveys. This paper presents a modification of the randomized response technique which was employed by Chilton Research Services (CRS) when faced with the question: "Can a technique be administered successfully as part of a telephone survey?"

The Chilton Model

Chilton Research Services was commissioned by the New York State Division of Substance Abuse Services (DSAS) to conduct a pilot study

to determine the data collection strategies that are both cost-efficient and statistically reliable in collecting information pertaining to drug and in alcohol use. The three major issues to be addressed were: (1) Can data on drug and alcohol use be obtained by means of the telephone? (2) Can the randomized response technique of asking sensitive questions be modified for use on the telephone? (3) Can this technique result in responses which are more reliable and valid than those obtained by direct questioning?

There were six key factors which had to be addressed in designing a version of the randomized response technique for use on the telephone. These were:

1. Most of the variations of Warner's model which are cited in the literature present the respondent with a flash card that has the two statements written on it. In addition, the respondent is given a randomizing device and certain rules to remember for selecting the statement to which he should respond. When one is interviewing over the telephone, it is unreasonable to assume that the respondent will remember the two statements and the rules. Therefore, we decided that a technique employing only one statement should be designed.

2. A randomizing device had to be chosen which a large percentage of households would have available. For example, the probability of a household having a die available would be quite low.

3. The randomizing device and/or the wording of a question had to have a known probability and not equal to one-half.

4. It was necessary to choose a randomizing device which would optimize the percentage of responses based on the "truth" and not on the result of the device.

5. New York State was interested in getting data on both the prevalence and incidence of drug use and needed questions to reflect this.

6. The selected technique must assure the respondent that he can report sensitive information without fear of reprisal.

After much thought, it was decided that the randomizing device would be three coins. Each individual would be asked to toss his coins before each question and to respond by using certain rules. The following instructions were read over the telephone to the respondents:

> Now I am going to ask you some questions about your use of other drugs. Some people are reluctant to answer questions about their use of these drugs so I am going to ask you in such a way that neither I nor anyone else will ever know what the truth is about you. We are going to ask these questions of hundreds of people. We will only be able to figure out what the proportion of users is; we will never be able to determine whether you are a user or not.
>
> First, let me explain how the procedure works. Would you please get three coins and a pencil and paper. Got them? I'm going to ask you to flip all three coins before asking each question. If all three are heads, I want you to answer my question with "Yes" even if that's not the truthful response. If all three coins are tails, I want you to reply "No" to my question. And if some of your coins are heads and some are tails, I want you to answer my question with the truth. This method of answering questions may lead to certain inconsistencies in your responses, but don't worry about it. Remember we're not interested in individual responses, but in averages.
>
> To help you remember, why don't you write down that three heads means reply "Yes," three tails reply "No," and any combination of heads and tails means you give me the truthful response.
>
> Let's go over an example together. If my question were: "Do you live in New York State?" How should you reply if you tossed:
>
> A. 3 heads (Yes)
> B. 3 tails (No)
> C. 1 head and 2 tails(The truth - Yes)
>
> Let me point out again that I have no way of knowing whether you're replying with the truthful response. If you say "Yes" to my question it could be because you tossed three heads or because you really do live in New York State, the truthful answer. It doesn't matter to me which of these is the reason why you said "Yes." Now let's start.

Before reading any question, the interviewer told the respondent to toss his coins. After each question was read the interviewer reminded the respondent to reply according to the coins. As an example, the interviewer may read:

> "Toss your coins. The question is: Did you ever use cocaine? Look at your coins. According to your coins what is your answer?"

This format was used to ascertain prevalence data for four illicit drugs: Cocaine, LSD or other Psychedelics; Angel Dust or PCP, and Heroin. In addition, the questions were modified in an attempt to find out <u>when</u> people began using these drugs. As an example, the interviewer would now read:

> "Toss your coins again. Did you try Heroin for the first time after January 1, 1979? According to your coins, what is your answer?"

For these questions, interviewers pointed out to the respondent that a truthful response of "No" means one of two things, either (a) he never used heroin or (b) he began using Heroin <u>before</u> January 1, 1979.

In each of these examples, the known probabilities would be:

1) Answering "Yes" because the respondent tossed 3 Heads = (1/2)(1/2)(1/2) or 1/8

2) Answering "No" because the respondent tossed 3 Tails = (1/2)(1/2)(1/2) or 1/8

3) Answering with a Truthful Response because the respondent tossed any combination of Heads and Tails = (1 - 1/8 - 1/8) or 3/4

As can be seen, 75% of the time the respondents were actually responding with the truth but interviewers were unable to determine whether the response was based on the coins or the truth.

In gathering incidence data, the instructions for responding were changed slightly to incorporate different answer categories. Again, the respondents were asked to flip three coins. If three tails occurred, the person was asked to reply "Never" to having used a specific drug. On the other hand, if the person obtained any combination of heads and tails, he was told to be truthful. If the person got three heads, he was to tell whether or not his birthday fell within the past 30 days, in the past 6 months, or more than 6 months ago. For each of the four drug type questions, the respondent used a different reference; i.e., his birthday, his mother's birthday, his father's birthday, the birthday of a spouse, sibling or best friend. As an example of this question, the interviewer would read:

> "Jot down your mother's birthday. Now toss your coins. For this question, if you get some heads and some tails, tell the truth. If you get all 3 tails answer "Never," and if you get all 3 heads, tell me whether the date of your mother's birthday was within the past 30 days, the past 6 months, or more than 6 months ago.
>
> When was the most recent time you used Angel Dust? According to your coins, was it: within the past 30 days, within the past 6 months, more than 6 months ago or never?"

In using the above instructions, there was a (1/8)(1/12) probability of drug use within the past 30 days; there was a (5/12)(1/8) probability of drug use within the past 6 months and a probability of (6/12)(1/8) of drug use more than 6 months ago when the respondent tossed 3 heads. These probability estimates were based on the assumption that the distribution of birthdays was rectangular throughout all 12 months.

Method

For this pilot study, 203 households in the five boroughs of New York City were interviewed. The sample was drawn utilizing a combination of random digit dialing and numbers found in telephone directories, with an oversampling of Manhattan at a ratio of 2:1. Of this sample, 115 respondents were randomly selected for the randomized response technique and the remaining 88 were asked the illicit drug questions directly without any attempt to mask their responses. Of the 115 respondents who were asked to employ the randomized response technique to describe their drug use, only 60 (52.2%) agreed to use it. Thirty-three persons rejected the technique because they claimed to have never used any illicit substances and using it would be a waste of their time. The remaining 22 persons rejected the technique because they did not want to be bothered with using the randomizing device and offered to tell the truth instead.

Results

Prevalence of Drug Abuse

There were four comparable questions in the randomized response and direct questioning questionnaires which permitted comparison between the two groups' drug use. These questions asked whether or not the respondents had ever used Cocaine, PCP, LSD (psychedelics), or Heroin. Respondents had also been asked to describe when they had used these drugs, but the direct questioning respondents were only asked these questions if they admitted to illicit drug use. In

contrast, the questions about when drugs were used in the randomized response technique were asked of every respondent. The incidence questions also were not the same for the two groups because of skip patterns, and therefore could not be compared.

Based on Fidler and Kleinknecht's (1977) approach, the mean maximum likelihood estimator, $\hat{\pi}$, for the population proportion, π, may be estimated with the following formula:

$$\hat{\pi} = \frac{\lambda - \theta}{P}$$

To estimate the variance of $\hat{\pi}$, the formula below is suggested:

$$\text{Var } (\hat{\pi}) = \frac{\lambda (1 - \lambda)}{NP^2}$$

Where P = probability that the randomizing device will direct respondents to answer truthfully; θ = probability that the randomizing device will direct respondents to answer "Yes"; and N = total sample size.

This estimate of π can be used to obtain the mean estimates for each type of drug use. On the other hand, the direct questioning technique is based on the assumption that the mean use for each drug represents a true population estimate. The mean proportion estimate, $\hat{p}$, and its variance may be estimated by the formula:

$$\text{Var } (\hat{p}) = \frac{\lambda (1 - \lambda)}{N}$$

Welsh's t' statistic with its adjustments for degrees of freedom can then be used to test between the mean estimates of the proportion of drug use generated by both techniques.

Table 1 presents the proportions of respondents answering positively to Cocaine, PCP, LSD, and Heroin use for the 88 persons originally drawn

for direct questioning and the 60 persons who accepted using the randomized response technique. It must be remembered that 22 persons chose to tell the "truth" through direct questioning rather than use the randomized response technique and another 33 respondents did not want to use it because they stated that it would be a waste of time since they had never used any type of illicit drug. The responses of the persons who rejected the randomized response technique were not included in the analysis shown in Table 1 because they might reflect biases derived from simply not wanting to use the randomized response technique.

Table 1: Proportions of Respondents Answering Positively To Cocaine, PCP, LSD, and Heroin Use By Direct Questioning and Randomized Response Techniques

DRUG	TECHNIQUE				
	DIRECT [a]		RANDOM [b]		t'
	$\hat{p}$	$\hat{SD}$	$\hat{\pi}$	$\hat{SD}$	
COCAINE	.11	.03	.21	.08	1.17
PCP	.02	.01	.03	.06	.16
LSD	.04	.02	.01	.06	.47
HEROIN	.03	.02	.10	.07	.96

NOTE - WELCH'S t' STATISTIC WAS USED TO COMPARE MEAN PROPORTION ESTIMATES.

[a] n = 88 FOR DIRECT QUESTIONING

[b] n = 60 FOR RANDOMIZED RESPONSE TECHNIQUE

The results presented in Table 1 indicate that there were no significant differences in the rates of Cocaine, PCP, LSD, and Heroin use described by the 88 persons that were questioned directly and 60 that used the randomized response technique.

Other Findings of Interest

Comparison of Randomized Response Players and Non-Players

Since the randomized response technique was not shown to produce significant differences from direct questioning, it was important to assess the feasibility of using this technique for all questioning. One major caveat to overall acceptance was that 33 respondents targeted for this technique refused to play the "game" because they had never used drugs and playing it would be a waste of time. Another 22 respondents did not want to play and stated that they would tell the truth. Therefore, 52 percent of those selected to use the randomized response technique eventually did use it. Were there any significant background differences between the 22 non-players who told the truth, the 33 non-drug users who did not want to play, the 60 who did use the randomized response technique, and the 88 who were originally chosen for direct questioning? The latter respondents, in this instance, do not include the 22 non-randomized response players who were asked direct questions. Such differences might suggest ways of identifying who might be most receptive to using the randomized response technique.

Chi-square tests were conducted among the background characteristics of the four previously described groups of respondents, and significant

differences were found. The 60 persons who did use the randomized response technique were more likely to be single than the other three groups ($p < .01$). A one-way analysis of variance of the four groups' mean ages was also conducted (F (2,197) = 8.24, $p < .001$), and the 33 non-drug users originally scheduled for the randomized response technique and the 88 scheduled for direct questioning were older than the 22 persons who had been initially scheduled for the randomized response technique who, in turn, were older than the 60 people who actually used the randomized response technique. The groups' mean ages were 44.52 (SD = 21), 41.46 (SD = 18.68), 35.18 (SD = 16.16), and 28.92 (SD = 12.95), respectively.

To estimate whether or not the 55 persons who had not wanted to use the randomized response technique might be avoiding answering drug use questions, the four groups' rates of responding to marijuana use, which was asked of everyone directly, were compared. Table 2 displays this comparison.

Table 2: Marijuana Use by the Four Groups

		Non-Player Non-Drug User	Used RRT	Direct Question	Rejected RRT Told Truth	Total
Marijuana Use	Yes	12	38	34	14	98
	No	21	22	54	8	105
TOTAL		33	60	88	22	203

The resultant chi-square for this comparison was 12.67(3) which was significant beyond the .01 level, two-tailed test. The persons who played the "game" and those who rejected it and told the truth had comparable rates of use which were higher than those who had been scheduled to play the game and had never used Cocaine, PCP, LSD, or Heroin, and those who were initially selected for direct questioning. Interestingly, these two latter groups' rates of use were comparable too.

The 88 persons originally scheduled for direct questioning and the 22 persons who rejected the randomized response technique in favor of direct questioning were also compared with respect to their use of Cocaine, PCP, LSD, and Heroin. Table 3 shows the significant results for Cocaine and LSD. None of the 22 randomized response rejects had used PCP or Heroin.

Table 3: Cocaine and LSD Use For The Two Groups of Direct Questioning

		Direct Questioning from Start	Reject RRT for Direct Questioning	Total
Cocaine	Yes	10	7	17
	No	78	15	93
TOTAL		88	22	110
LSD	Yes	4	5	9
	No	84	17	101
TOTAL		88	22	110

The chi-square for Cocaine and LSD were 4.18(1) and 5.51(1), respectively. Both were significant beyond the .05 level. The 22 randomized response

rejections described higher rates of Cocaine and LSD use than the 88 who had originally been targeted for direct questioning.

Implications

The implications of the comparisons among the 33 non-drug users who did not want to use the randomized response technique, the 88 persons originally targeted for direct questioning, the 60 who used the randomized response technique, and the 22 who rejected the randomized response technique in favor of direct questioning indicate that younger single persons who have used drugs may be more predisposed to the randomized response technique. Persons who are not sensitive about their drug use may prefer direct questioning, and appropriate screening questions should be developed to direct respondents to the most acceptable technique. Perhaps, simply asking someone if he feels uneasy about answering questions about his drug use is sufficient to invite him to use the randomized response technique.

Finally, the relevance of the randomized response technique for obtaining sensitive personal information cannot be solely evaluated by the refusal rate. The magnitudes of the significant differences, if there are significant differences, between endorsement rates for sensitive questions must be judiciously weighed to ascertain whether or not the additional interviewing length and complexity introduced by the randomized response technique, as opposed to direct questioning, are warranted. One must remember that the sample size for this study

was small but its results certainly indicate that more research is needed. It may in fact turn out that questions dealing with illicit drug usage are not as sensitive as we believe them to be. The key issue may be trust; i.e., once the respondent believes that the responses he gives the interviewer will be kept confidential, the method of asking the question may be secondary.

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